

A High Efficiency 30 K Cryocooler with Low-Temperature Heat Sink, Phase II

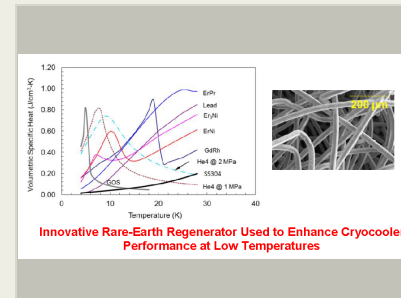
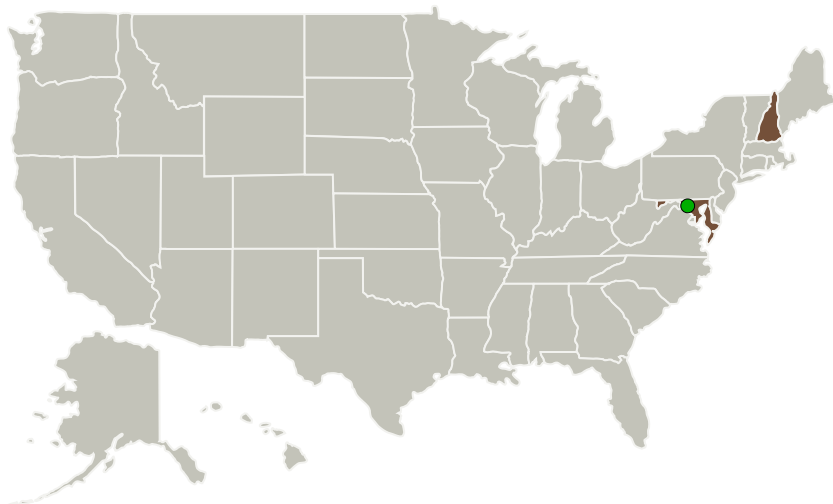
Completed Technology Project (2016 - 2018)



Project Introduction

Future NASA planetary science missions have very limited access to solar power and therefore reducing the cryocooling system power input is even more critical than for earth-orbiting satellites. On this program, Creare proposes to develop and demonstrate an innovative Stirling cryocooler that efficiently produces refrigeration at 30 K and rejects heat at about 150 K. A key component of the proposed cryocooler, its regenerator, will be optimized on this program to obtain high efficiency over this operating temperature range. The innovation is a regenerator fabricated by a unique process to enhance its heat capacity near its target cooling temperature and, therefore, increase the overall thermal efficiency of the cryocooler. The proposed cryocooler is built on technologies developed for commercial Stirling cryocoolers that are extremely compact and efficient while rejecting heat at 300 K. In Phase I, we proved the feasibility of our approach by demonstrating the regenerator fabrication process and its high heat capacity near 30 K, and showing the high thermal efficiency of the 30 K cooler by design and analysis. In Phase II, we will fabricate a Stirling cryocooler that incorporates the regenerator with high heat capacity, optimize the cooler, and deliver the cryocooler to NASA for further performance characterization at the end of the program.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	New Hampshire

Project Transitions

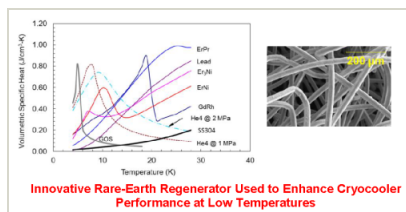
▶ **May 2016:** Project Start

✓ **April 2018:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139451>)

Images



Briefing Chart Image

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(<https://techport.nasa.gov/image/127972>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Creare LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Weibo Chen

Co-Investigator:

Weibo Chen

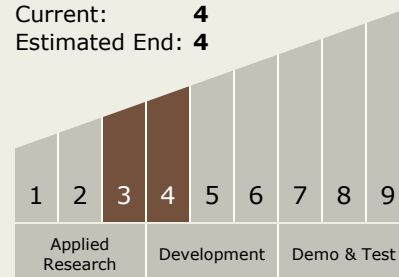
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Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System